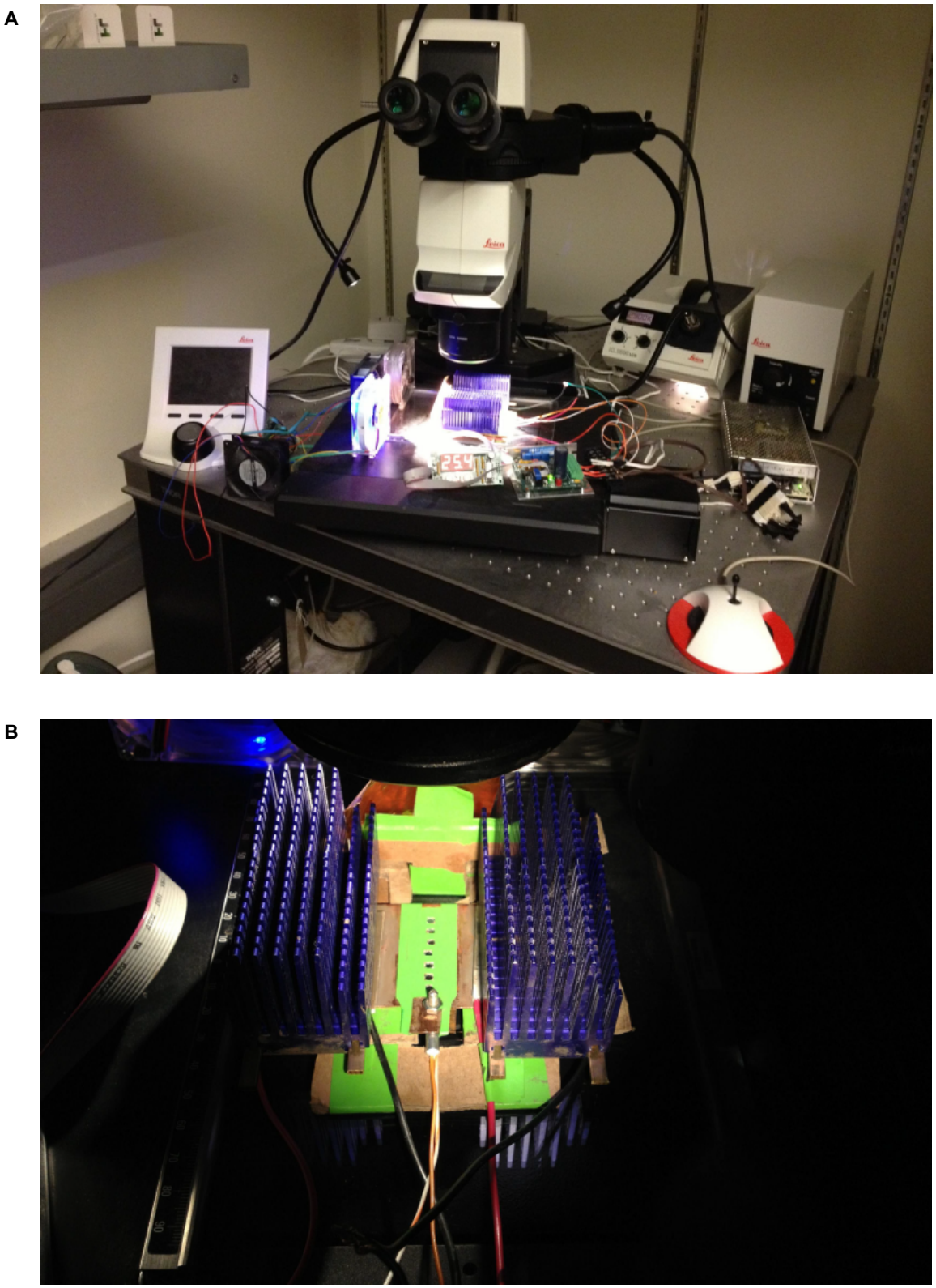

Figure S1. Microscopy imaging setup (A) The imaging setup, showing the dissecting microscope with temperature control apparatus on the automated stage. (B) A close-up view of the temperature controlled platform flanked by heat-sinks (blue) that sit atop the Peltier thermoelectric controllers. In the center is a copper plate, with a thermister at the bottom to monitor plate temperature. The holes in the green masking tape line up with holes drilled through the copper plate and lined with a gas-permeable membrane. The masking tape helps retain the halocarbon oil.

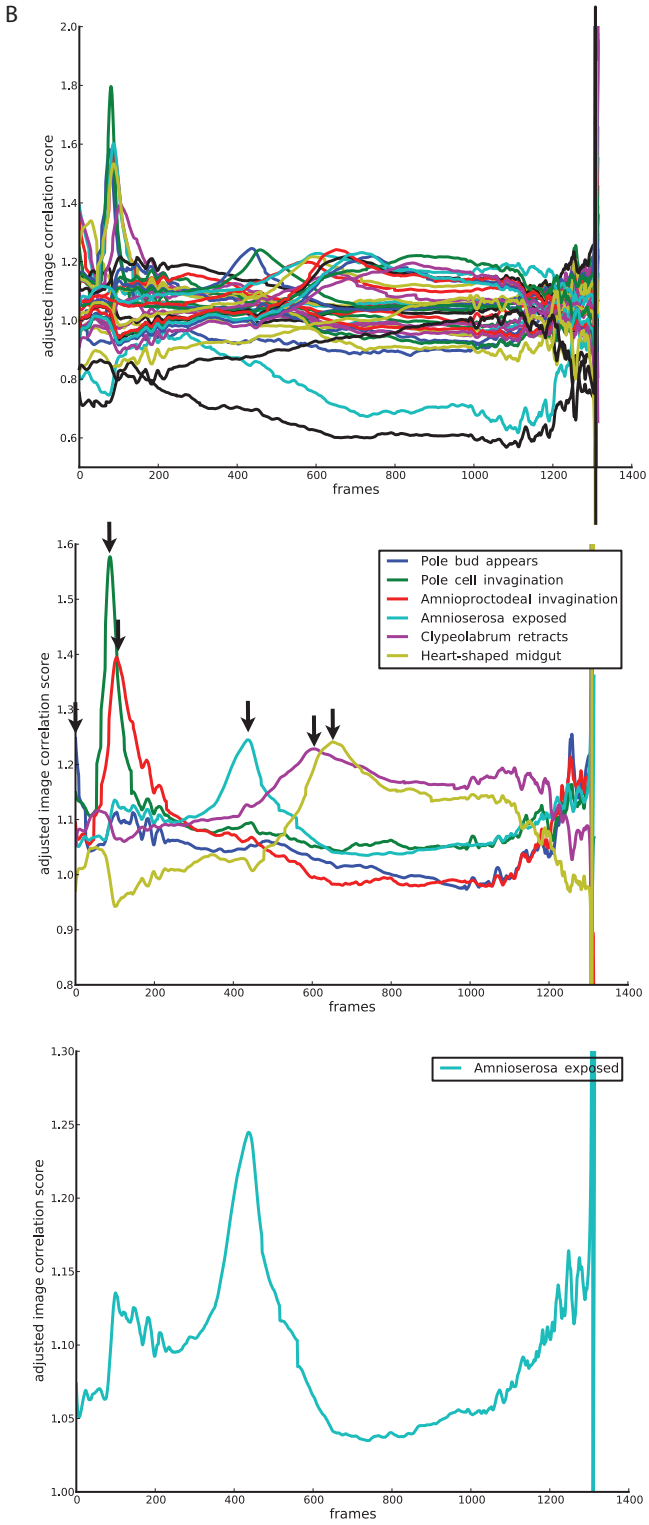

Figure S2. Events were predicted by computational analysis before manual verification (A) For every time-lapse, each frame was correlated to each of the 34 composite images. (B) The running scores for 6 different events, with their maxima (black arrows) highlighted to reflect the estimated event time. (C) The time of amnioserosa exposure is estimated by the strong correlation at about 450 frames into the time-lapse.

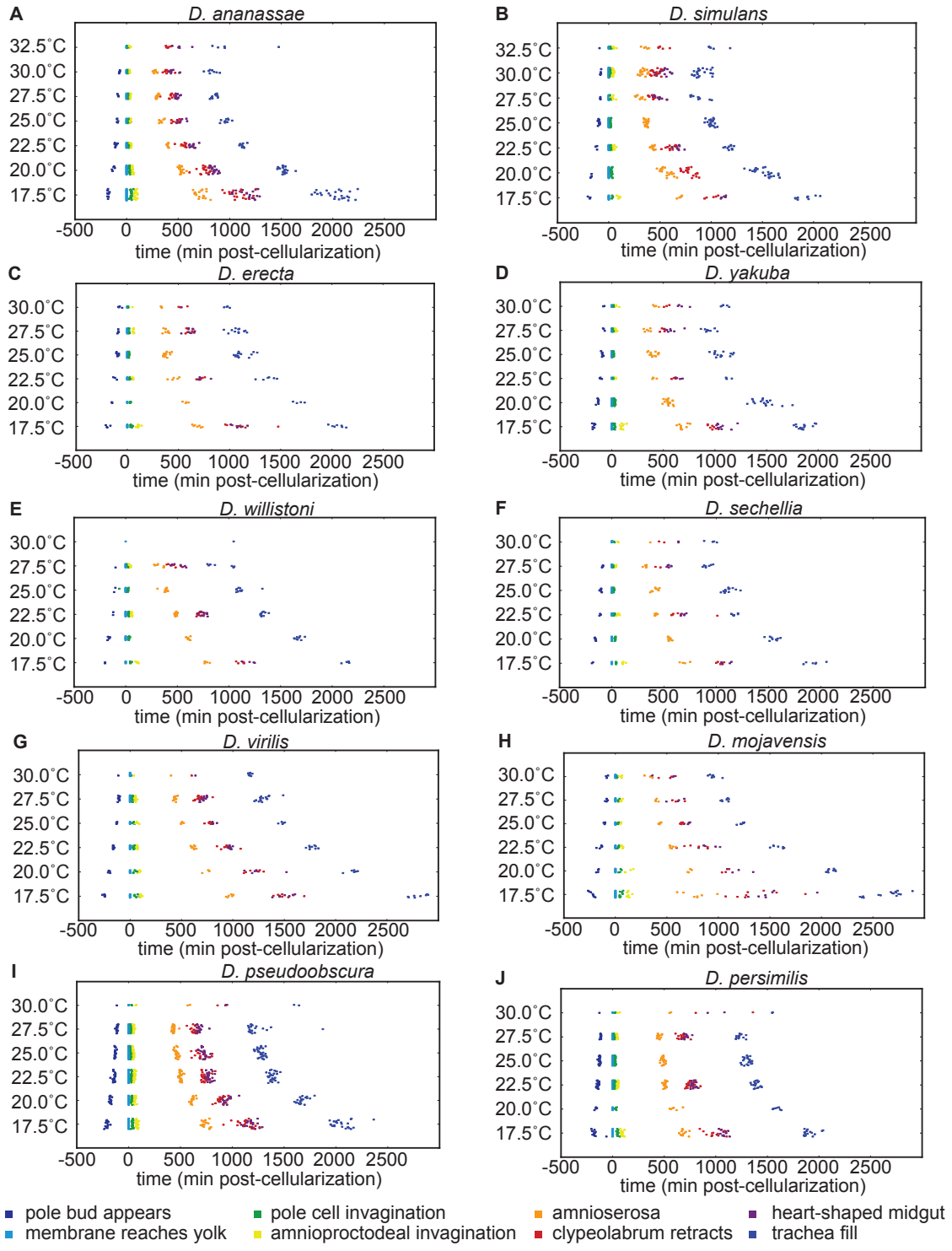

Figure S3. Ten species of *Drosophila* exhibit dynamic response to temperature changes (A-F) There is some variation species to species, but all tropical *Drosophila* exhibit a similar temperature response-curve to *D. ananassae*. (G) Temperate *D. virilis* also has a steep response, though intermediate to the previous two groups. (H) Sub-tropical *D. mojavensis* has a steeper temperature response, though a similar high temperature developmental time. (I,J) Alpine *D. pseudoobscura* and *D. persimilis* have a cold response like the tropical species, but longer developmental times at warmer temperatures.

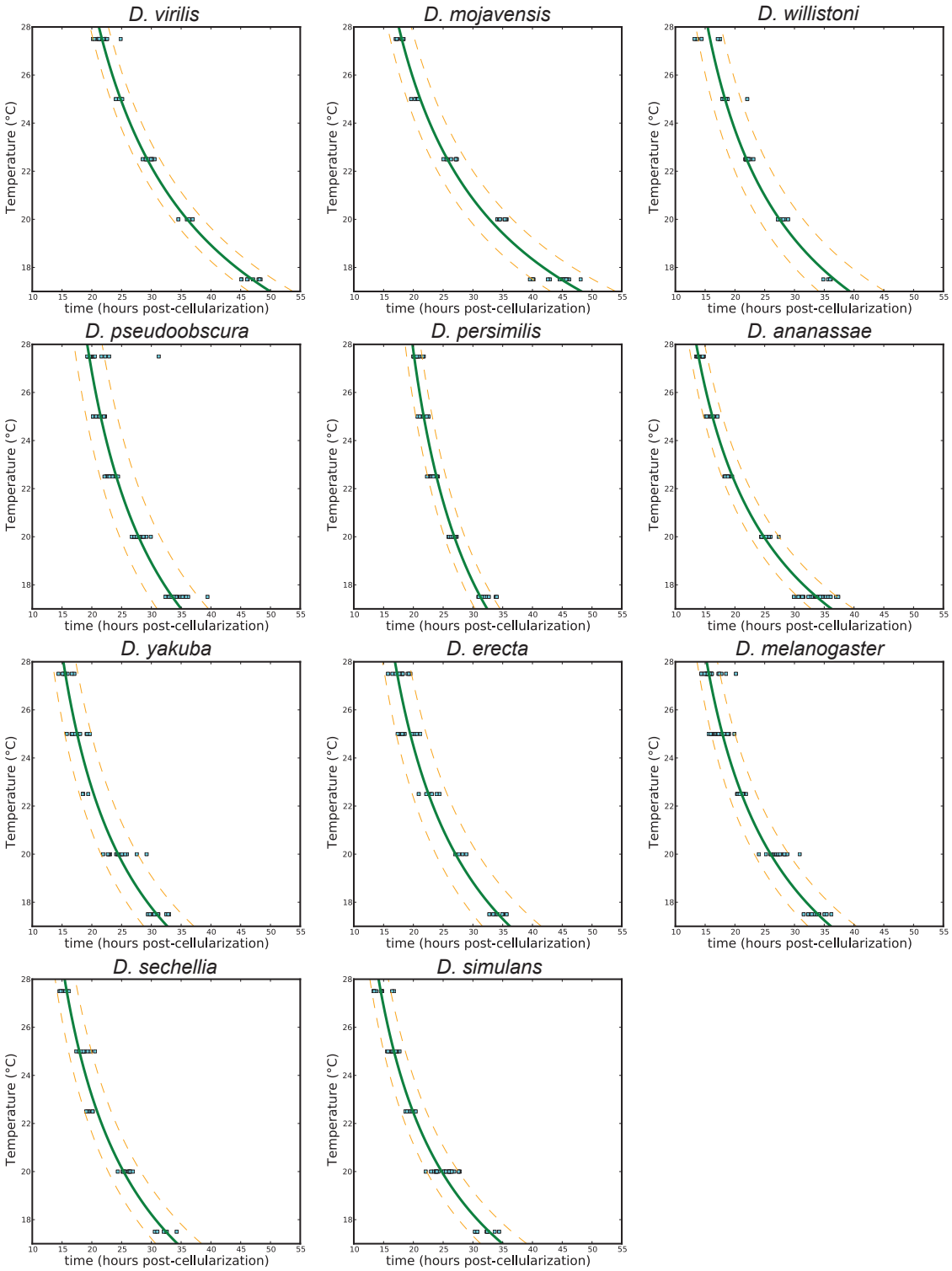

Figure S4. Prediction of future observations of development at different temperatures The behavior of developing embryos can be predicted. The mean line (green) and the 95% confidence prediction interval for future observations (dashed orange line) are shown for each species

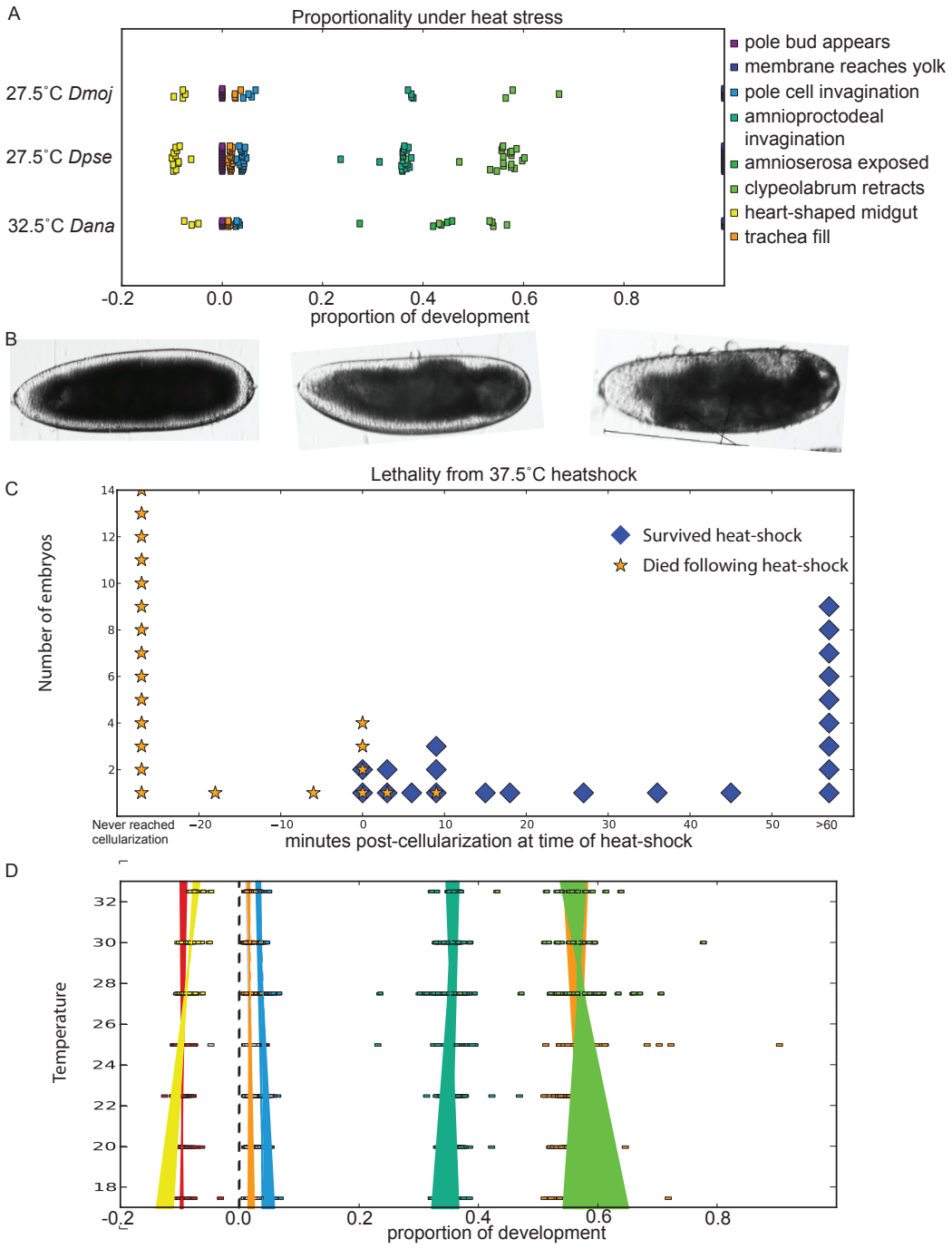

Figure S5. Heat-stress affects syncytial developmental proportionality and morphology (A) At heat-stress temperatures, the proportionality of developmental stages is affected in some, but not all, embryos. (B) Heat stress in *D. melanogaster* at 32.5°C affects morphology during yolk contraction and gastrulation. Embryos may exhibit asynchronous yolk-contraction (first image), uneven nuclear distribution during cellularization (second image), or disrupted morphology during gastrulation (third image). (C) Heat shock at 37.5°C for 30 minutes reveals embryos sensitivity prior to the completion of cellularization. Most animals that had completed cellularization survived heat-shock and continued to develop properly (blue diamonds), while no animals that had not completed cellularization prior to heat-shock survived. All embryos that died (orange stars) exhibited severe morphological disruptions. (D) Linear regression of stages across different temperatures reveals that, despite significant variance in later stages (shown in colored bars), only the pre-cellularization time point is affected by heat-stress enough to exhibit a significantly different slope between higher temperatures (27.5°C and above, yellow bar) and lower temperatures (25°C and below, red bar).